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ANIMAL KINGDOM

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ANIMAL KINGDOM

Bulletin of the New York Zoological Society

In This Issue

The Frilled Lizard *Cover*

The Bower-birds *A. J. Marshall* 34

Big Bluff from Australia *James A. Oliver* 44

Spring Comes Along *Donald T. Carlisle* 47

Zoo News in Pictures *Sam Dunton* 48

Those Puzzling "Little Toms" *Myron Gordon* 50

Creatures of Sea Ice and Tundra Barrens *Katharine Scherman & Richard S. Miller* 56

News from the Conservation Foundation 61

Behind the Scenes 62

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Trustees for Animals

IN THE GENERAL RUN of human affairs optimism "pays off" far better than pessimism. This page, however, is not intended to comment about people but about animals – although it will do no harm if we people occasionally recall that we, too, are of the *animal kingdom*.

Animals have their own special problems but the hardest one most of them face is what to do about human beings. This is a grim question for animals and they have been forced to recognize that they are at our mercy. Except within the tender religions of the people in the Far East man's mercy towards other living things has for long been practiced so little that wild animals, the earth over, have come to hold man in uncontrollable fear.

The impression seems justified that, as a general rule, people of the Western World have had less compassion for animals than some of the peoples in the Far East, whose very religion has inculcated the conception of the inviolability of all living things. Nevertheless, now we have growing reason for optimism for within recent times a new conception has arisen that is growing ever stronger throughout the Western World. This conception finds expression in many ways including the steadily increasing recognition that man has become a trustee for wild living things. We are discovering that the quality of mercy "is twice blest . . . it blesseth him that gives and him that takes."

Fairfield Osborn

Weeks of patient waiting went into the making of this photograph of a Yellow-breasted Bower-bird posing in its decorated bower.

Photograph by E. Thomas Gilliard

We Are Beginning to Understand THE BOWER-BIRDS

By A. J. MARSHALL

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MILES FROM THE HOMESTEAD of an inland Australian sheep station (ranch), a man returned to his automobile and found its ignition key missing. It seemed that he was stranded. He knew that there could be no practical joker in the neighborhood. So, familiar with the habits of the Spotted Bower-bird (*Chlamydera maculata*), he walked half a mile to a bower whose location he knew. The shiny key and ring were there on the display ground.[1]

Another bushman used to leave his glass eye in a cup of water by his bedside every night. In camp he awoke one morning to find the cup upset and the eye gone. The bushman was very attached to this particular eye and took a low view of its disappearance. The camp dog was suspected and had a poor time of it for the next few days. An autopsy was projected, but fortunately postponed. A fortnight passed. Then one of the bushmen, short of lead with which to make bullets to shoot a troublesome brumby stallion (wild horse) went to a nearby bower-bird's bower hoping to find some. He found not only the desired lead, but, in addition, his mate's glass eye. It stared vacantly up from among the bleached bones, shells and odd pieces of shining metal and glass that the birds had accumulated for use in their display.[2]

In the Ord River country of West Australia a gentleman named Edward Delaney lost his spectacles. They were found at the bower of a Great Gray Bower-bird (*Chlamydera nuchalis*).[3] The collector S. W. Jackson had to retrieve stolen table silver and his entomological forceps from a bower. He reported also that "anything bright"

in his camps had to be kept shut up in a box.[4] Precious opal has been found on display ground in opal-bearing country as well as small glistening nuggets of gold embedded in pieces of quartz.[5] Bower-birds have been known to steal jewelry from dressing tables near open windows. After country race meetings Australian aborigines sometimes make a tour of nearby bowers to collect odd silver coins found and taken there by the scavenging birds.

Another writer reported that quantities of metal staples were stolen from along a line of newly sunken post holes. Nuts, bolts, thimbles, screws, penknives, wire, broken glass (especially) have been found at bowers. In the old days, when unpainted metal buttons were worn, bower-birds sometimes hopped close to bushmen in order to inspect them.

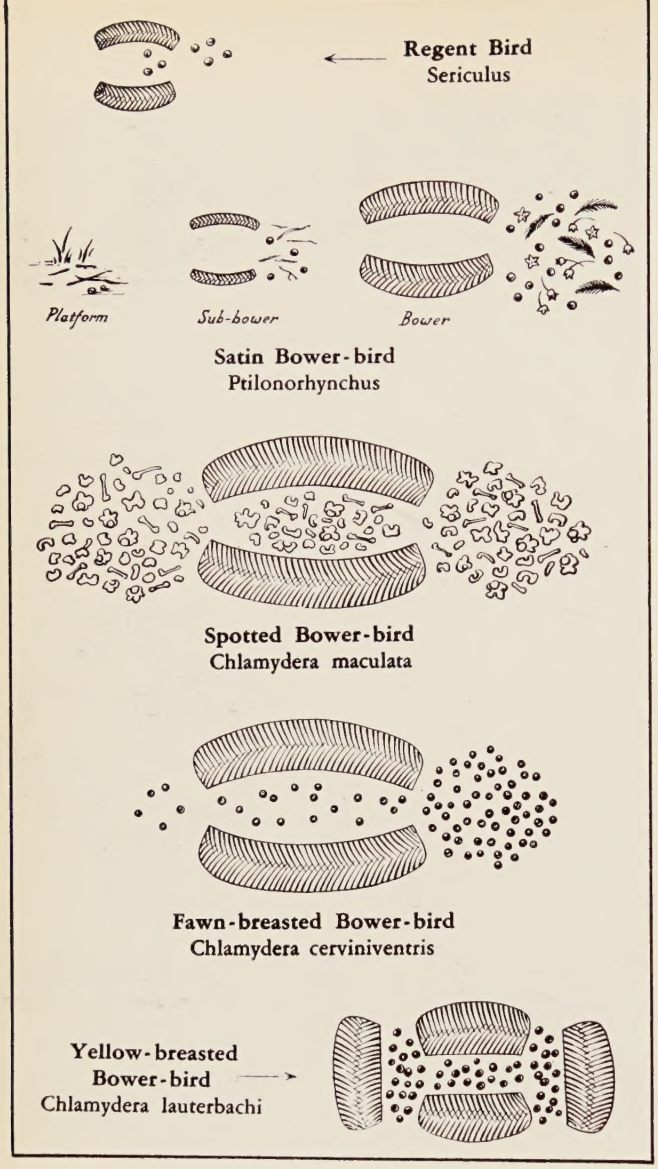
These stories, of course, seem wildly improbable — but they are, in fact, true. They all relate to the Spotted and Great Gray Bower-birds. These species inhabit the dry inland, and lightly forested northern areas of Australia. They habitually accumulate at their bowers great collections of bleached and reflecting articles.

Most people believe that bower-birds simply accumulate indiscriminately a heap of varied, colorful rubbish. In actual fact, the different species select their bower decorations with a remarkable discrimination. The Satin Bower-bird (*Ptilonorhynchus violaceus*) of the eastern Australian rain forests and their fringes collects only objects colored blue, greenish-yellow, gray and brown. At one country hotel I know, Satin-birds regularly invade the laundry and purloin washing bluebags. A display ground nearby was always smothered with bluebags, together with the usual array of freshly picked bluebells, greenish-yellow *Billardiera* blossoms, pieces of gray sloughed snakeskin, brown snail-shells and other objects. Flower growers in districts where Satin-birds live usually have to shoot them if they are determined to keep them out of their gardens. The birds become so bold that they will wrestle with "spikes" of delphinium blossoms larger than themselves within a few yards of the aggrieved gardeners. They like also petunias, cinerarias, cornflowers, irises and hyacinths. These are quickly wrenched off and carried to bowers in the rain forest to join the odd blue and greenish-yellow bush flowers and the motley accumulation of blue parrots' feathers, bus tickets, glass, fragments of blue-bordered china, discarded hair ribbons and other *miscellanea* there. An aviculturalist who unwisely tried to keep blue finches in the same aviary as a male Satin-bird found that the finches were killed one by one and taken as decorations to the display ground. Finches of other colors were not molested.[6]

Here is the bower of the Yellow-breasted Bower-bird in broader view, showing the assortment of round red, blue and green seeds and blue clay or pebbles used by this bird.

Photograph by E. Thomas Gilliard

Bower-birds (Ptilonorhynchidae) are passerine (perching) birds not unrelated to the birds of



BOWERS OF AVENUE-BUILDERS

Eight species of bower-birds widely distributed through Australia and New Guinea are builders of the avenue type of bower. Essential features are a basal platform of twigs on which is set a double wall of twigs to make a central avenue. Colored objects are placed on the display grounds at one or both ends.

Drawings on Pages 36 & 37 from the Author

paradise. They exist only in Australia and New Guinea. The males are often very beautiful. Their bowers are built of twigs, always on the ground, and have no direct connection with the nests. These are placed in trees, often some hundreds of yards away. Early Australian explorers who first observed bower-birds' display grounds thought that they were a kind of toy built by native mothers for the amusement of their children. Very soon, however, it became known that birds, not aborigines, made them. The first bowers found were of the *avenue* type — a pair of symmetrical walls of twigs with just enough room in between for a single bird about as big as a small pigeon to pass through. At one, or sometimes both, ends of the central avenue is always arrayed the pile of distinctive display things. Some species scatter their decorations through the avenue as well. One avenue-builder, the Yellow-breasted Bower-bird (*Chlamydera lauterbachi*) of New Guinea, has extended the simple double-wall plan by adding two more walls at right angles and so constructs three avenues. In all of these passages it strews blue, green and red berries, pieces of blue clay and slate-colored pebbles.

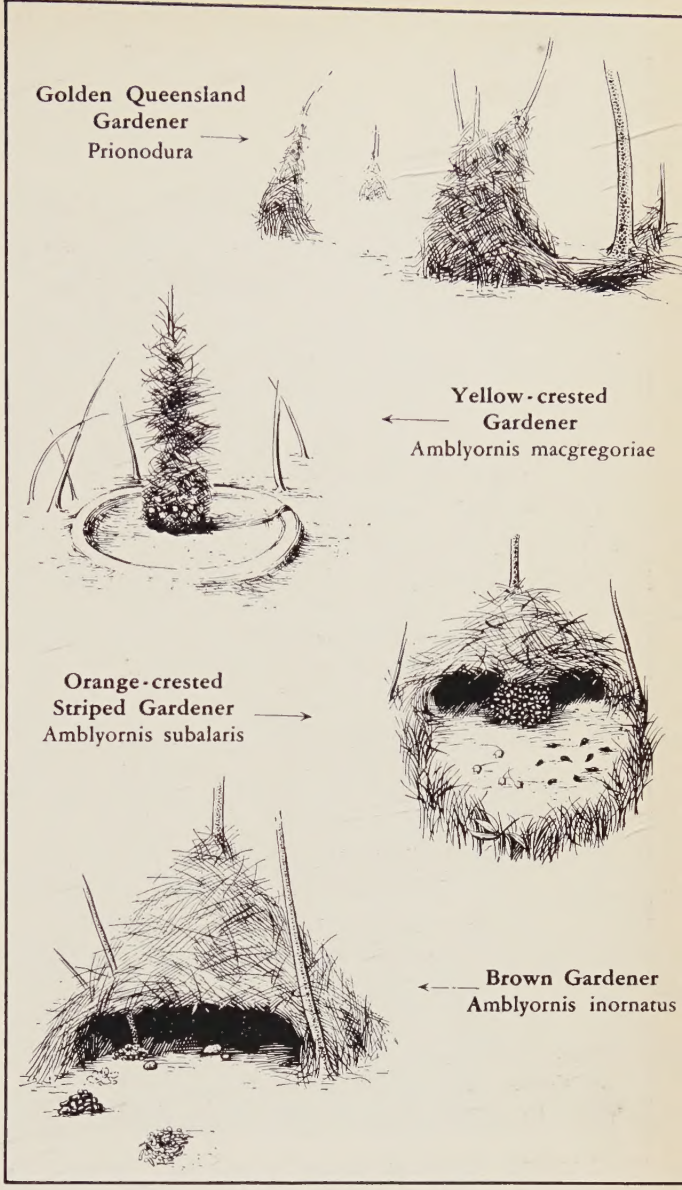
Apart from the avenue-builders there exists a group that I have called the *maypole*-builders, about which very little is known.[7] With one exception all are confined to the dense rain forests of tropical New Guinea. In each case the fundamental features of the bower are a rigid supporting central tower (a thin sapling growing in the forest) and a cone of fabric that is packed about its base. The tower sometimes supports a spherical (as built by *Amblyornis inoratus*), or a hemispherical (*A. subalaris*) waterproof hut or a secondary tower of fabric (*A. macgregorii*). These maypole bowers are sometimes fronted with a living lawn of transplanted moss and this display ground may be decorated with fresh flowers, fruit, fungi, colored beetles' wingcases or snail-shells. Thus the maypole-builders have come to be known as the Gardener Bower-birds. The Golden Queensland Gardener (*Prionodura newtoniana*) decorates the spacious fabric of its double-towered maypole bower with living orchid plants. These continue to grow and flower on the new site. Very little is known about the maypole-builders because all inhabit tropical jungles remote from heavy European settlement.

Yet a third type of bower is built by the Gold-crested Black Bower-bird (*Archboldia papuensis*) of New Guinea. This beautiful bird was discovered by the American Museum of Natural History-Archbold Expedition as recently as 1938[8] and the first good description of its bower was

not published until last year.[9] The Black Bower-bird builds neither an avenue nor a maypole bower. It simply clears a patch of jungle floor and strews the space with dry fern fronds, grass and twigs. To this primitive circus arena it brings a small collection of snailshells, black beetles' wings and blue berries. Very few people have seen the Black Bower-bird, but enough display grounds have been found to make it clear that it never actually *erects* a bower-like structure on its elementary arena.

In addition to the above three stems of bower-bird evolution, the family Ptilonorhynchidae, as at present constituted, also includes the distinctive Catbirds. These, of course, are of no relation to the North American bird of that name. They are exclusively jungle dwellers which, although they do not build bowers, are obviously derived from the same ancestral stock. Of the Catbirds, two (*Ailurœdus*) are greenish in coloration and rarely leave the heavy concealing foliage. The third, the famous Stagemaker, or Tooth-billed Catbird (*Scenopœetes dentirostris*), has taken partly to the forest floor, developed a harmonizing brownish plumage and a special "toothed" bill. With this remarkable beak it laboriously saws through the petioles of leaves. When these are severed, it carries them to a cleared space on the jungle floor and arranges them with paler under-surface uppermost, in conspicuous display. One Catbird, the White-throated species (*A. buccoides*), is confined to New Guinea. The second, the Green Catbird (*A. crassirostris*), is widespread right through from western New Guinea to southeastern Australia. The leaf-sawing Stagemaker is restricted to a relatively tiny "island" of jungle in wet, mountainous, tropical northeastern Australia.[10]

In all true bower-birds so far studied, the brilliant male displays to a female which sits impassively behind or within the bower. She takes no part in the performance. The sun flashes on his body plumage, or upon his erectile head or neck plumes as he gyrates energetically, often violently, in display to the accompaniment of a remarkable vocalization. He savagely drives all intruder males away from his display ground, the focal point of his sexual territory. When the Satin-bird, for example, leaves his bower to feed or bathe, a rival will quickly skulk in through



BOWERS OF MAYPOLE-BUILDERS

Except for the Golden Queensland Gardener, the maypole-builders are confined to the largely unknown tropical rain forests of New Guinea. A slim sapling, at the base of which is packed a cone of fabric, is an essential feature of the maypole bower and around it each species builds its own kind of structure.

the undergrowth and begin to wreck his bower. When the owner sees what is going on he returns with a swift rush of wings. The intruder always flees. He often snatches up a beakful of blue parrot's feathers or flowers as he retreats.

Some avenue-building bower-birds – the Satin, Spotted, Great Gray and possibly the Regent-

The Fawn-breasted Bower-bird builds an avenue and decorates its display ground principally with green berries of various kinds. It sometimes employs bleached objects also.

Photograph by Lee S. Crandall

bird (*Sericulus chrysocephalus*) choose their decorations specifically to match the most striking plumage and other physical features of their own species. It was formerly thought that the choice of ornaments was governed by the colors of the female[11, 12], but I have recently presented experimental evidence that the male Satin-bird at least chooses his display things to match the colors of rival *males*.[6] The females and young males of the Satin-bird are greenish in coloration, with brilliant blue eyes and yellow underwing coverts. The plumage has also various shades of brown and gray. We have seen that the Satin-birds' display ground is always smothered with these colors even though, in the forest, the bird has an unlimited range of color choice. When three or four years old, the males change their color to a brilliant lustrous blue-black and at the same time the beak changes from a dull horn to bluish, edged with greenish-yellow. It was not until 1954 that it was discovered that the curious choice of flowers colored yellowish-green (a shade relatively rare in nature) is related to the small, though conspicuous, similarly colored area on the beak of the adult blue-black male. In experiments, adult males ignored the detached horn-colored beaks of dead females and young males, but avidly brought the greenish-yellow beaks of old males to the display ground. With these they displayed vigorously to their watching females.

The Spotted and Great Gray Bower-birds have pallid ventral areas and lilac crests that glint silver in the sunlight. The males of these species bring bleached and reflecting objects to their bowers. The male Regent Bower-bird is brownish in the young male, and brilliant gold and velvet black in the adult. The decorations chosen in the bush are predominantly brown, black and occasionally golden.

On the other hand, some avenue-builders do not seem to try to match the rival's plumage with their decorations. The Fawn-breasted Bower-bird (*Chlamydera cerviniventris*) of North Australia and New Guinea chooses principally green berries. The Yellow-breasted Bower-bird (*C. lauterbachi*) of New Guinea collects red berries, blue berries, blue clay and slate-colored stones. Among the maypole-builders, too, there seems to be no correlation between plumage color and the decorations that the males bring to their bowers.

At least two of the avenue-builders are known to orientate their bowers in a special way. Thus, both the Satin-bird and the Great Gray Bower-bird point the avenue along the path of the sun. Other avenue-builders (e.g. Spotted Bower-bird) site it in any direction. So faithful is the Satin-bird to the north-south direction that when I experimentally altered the bearing of bowers the owner demolished one wall, altered the bearing of the other, and then built a new third wall from the twigs taken from the first. Soon it was pointing almost along the original line.[6]

All three avenue-builders that are at all well known have been found to paint the inner walls of their bowers. One of the first two recorded observations of this habit was made in the New York Zoological Park. In 1922 Lee S. Crandall was told of a blue male Satin-bird that nibbled particles of soft wood from a sieve carried by a keeper. It mixed the wood fragments with saliva and coated the inside walls of its bower with the resultant paste. Mr. Crandall placed a piece of dry rotten wood in the cage. The paint was now on the house, so to speak, and "an orgy of plastering followed."[13] A year or two before this, Nubling [12, 14] had seen bush birds use what was probably fruit pulp and several years later Gannon and several other Sydney naturalists saw birds crush in their beaks charcoal (from logs charred by bush fires) and then wipe a sticky black mixture on the bowers.[15] In the bush the Satin-bird often shapes with its beak a flat pellet of bark. This it holds towards the end of its bill while applying the paint. The manufactured tool acts as a combination sponge and stopper. As the bird wipes each twig the black suspension adheres and results in an embellishing black band on each side of the avenue.

The Spotted Bower-bird chews up dry grass with saliva and plasters twin reddish-brown bands of material on its bower walls.[16] The rarer Regent Bower-bird plasters its bower with fruit pulp.[17] It is not yet known if the habit is practiced by other species of avenue-builders. Relatively few of their bowers have been carefully examined.

A new bower and freshly collected bleached shells of the Great Gray Bower-bird of tropical North Australia. This species orients its bower north-to-south.

Both photographs by the Author

n intruder male Satin Bower-rd in the act of wrecking the ower of a rival. The display ound is in front and is strewn ith blue parrot's feathers, llow straw and snail-shells.

The hut-like bower of the Brown Gardener Bower-bird of New Guinea. The central "maypole" sapling and the basal cone are not shown. Decorations are fruit and flowers.
Photograph by S. Dillon Ripley

WHAT ARE THE ORIGINS and functions of these elaborate behavior patterns? Bizarre as they are, I believe that bower building, color selection, painting and so on are merely remarkable extensions of phenomena that hardly excite comment in more commonplace birds. Certainly I do not think that we need to postulate, as many have done, any special intelligence in bower-birds. The Satin-bird, which has achieved perhaps the most elaborate degree of ritualization of any known bird, is not sufficiently *intelligent* to scratch aside leaves under which favorite insect food has taken refuge in the aviary. It eats fruit and flying insects. It snaps up anything that moves, but lacks the elementary reasoning power to scratch aside concealing debris. The Stagemaker has not learned that a single simple downward jerk of the neck will almost certainly detach at least some of the leaves that it laboriously severs each morning to decorate its jungle arena. It has the nervous and muscular equipment to do the job more quickly (with at least some easily detached leaves), yet it has never discovered the simple short cut.[6]

Bower building, color selection, painting and so on seem to be governed by innate, unconditional reflexes. They are probably merely curious "larger-than-life" bower-bird extensions of quite well known avian activities. Take bower building and display, for example. Most, if not all, birds have some form of sexual display and many, as widely unrelated as pheasants, waders and birds of paradise, clear an arena on the forest floor. Again, many kinds of birds – e.g. doves, cormorants and cuckoos – will snatch up odd objects, twigs, flower petals and especially nest material, and use them momentarily in their everyday display. This kind of display, involving the use of nest material or some other handy substitute in an apparently inappropriate situation, is probably a form of *displacement activity* in the terminology of modern ethologists. Something akin to this can be seen in the nervous needless fumbling of the tie by a man waiting, for example, to make an important address. Such ac-

tivities have become ritualized, habitual and valuable in many animals, including especially bower-birds. I see bower building, for example, as a displaced nest building drive. Nest building in most species is of a bisexual nature. Only female bower-birds build nests; the males stay aloof from domestic duties and remain preoccupied with their beloved display grounds when the females go away to lay and incubate. Nest building (with twigs in the case of bower-birds) is under the influence of sex hormones. The same is true of bower building in the males. During the sexual season they have taken to arranging twigs in various ways in their display grounds, the focal point of their interest.

When I castrated male bower-birds they stopped building bowers and ceased to display. When I injected the castrates with male sex hormone the typical male display behavior was re-established.[18] The enchantment of the bower and the display with colored and other distinctive articles is probably simply a grotesque extension of the displacement activity that involves, in less "complicated" birds, the occasional seizing of a twig or a flower petal and its use in moments of sexual excitement.

Some bower-birds have gone further still and have come to select colors which harmonize with prominent physical features of rival males. We saw above how savagely the male Satin-bird defends his bower territory and how violently he (and males of other species, too) displays with the decorations he brings to the bower. In several (but not all) bower-birds, the displaying male seizes, and displays noisily and violently with, objects colored in the rival's image, so to speak. The male makes continuous threat gestures in display, but the threat is directed at the colored ornament, and not at the watching female. She stands impassively within or behind the bower with all the appearance of unconcern

The Golden Queensland Gardener built this and decorated it with living orchids. The "display stick" is just above the hat. Here the male probably displays his plumage.

Photograph by the Author

or, if we may use an expression that smacks of anthropomorphism, even boredom. The excitable display of the male, however, holds her interest. Its violence keeps rivals away. And so, if the male is sufficiently attractive and aggressive, the female will still be at the bower when the mating season arrives.

Likewise, bower painting is almost certainly displaced courtship feeding. Courtship feeding, practiced by innumerable species, is in itself a displacement reaction. The male bower-bird, kept for weeks to his display by the aloofness of the watching female, projects his innate tendency towards courtship feeding on to his bower. Some bower-birds rub fruit — a favorite food — on the bower. Some, as we have seen, have evolved a more elaborate mechanism involving chewed-up grass or ground charcoal. The resultant embellishing twin bands of black or brown pigment on the inside walls probably makes the bower more attractive to its owner and perhaps to the female as well.

The display continues for weeks or even months until (in some bower-birds at least) the forest becomes seasonally full of special insects on which the young will be fed. Bower-birds eat mostly fruit but, like most other birds, they change to an essentially protein diet in the breeding season. If, in captivity, the parents are deprived of protein food, the young die of malnutrition in the first ten days of life. When the seasonal harvest of cicadas, Christmas beetles and flying termites appears, the male transfers his physical attention from the display objects to the female which has waited so long beside the bower; she then goes off and begins to build her nest. After further delay she lays her eggs. She rears the young entirely without male assistance.

The male's display served to attract her to his territory months before. It then helped synchronize their respective internal reproductive apparatus and kept the pair together until the environment reached a condition appropriate for reproduction and the successful rearing of the young. I believe that it is the long period of sex hormone liberation, without physical contact, that has enabled the development of the extraordinary display activities described above. The male energies have flowed into a vacuum, so to speak, created by the female's unwillingness to mate until the environment became suitable for successful reproduction.

In advancing a hypothesis which seeks to explain the complex bower-building allied phenomena on essentially utilitarian grounds, I do not suggest that the birds fail to enjoy the bizarre and perhaps aesthetic activities that they perform. But whether this enjoyment has much in common with that of man engaged in comparable pursuits has yet to be proved. For example, although many bower-birds collect objects that appear beautiful to us, we have no proof that they are "beautiful" (in our sense of the word) to the bird. If all bower-birds made collections of bleached bones, less would be written about

In the luxuriant tropical rain forest of north-eastern Queensland live the Golden Gardener, the Green Cat-bird and the Stagemaker.

Photograph from Queensland Government

Each morning the Stagemaker places fresh leaves upside down on its stage, and sometimes breaks snail-shells on an "anvil" beside the display ground. Shells at lower left.

Photograph by S. W. Jackson

beauty or aestheticism. Yet nobody would suggest that the pile of dead bones and snail-shells is any less "beautiful" to *Chlamydera nuchalis* than is the rather more agreeable (to us!) collection of blue and red berries to *C. lauterbachi*.

We know that the choice of decorations is mechanical and inherited. A species that collects principally deep blue and lemon yellow never varies its display to red and white (nor even to pale blue and gold) as would a woman arranging flowers. We are now trying to breed bower-birds in London. If we succeed we will separate the young from the adults at an early age and thus discover how much more of their display is innate and how much, if any, is learned from the male parent. The evidence so far suggests that although bower-birds improve their performance with age and experience, their display activities are governed entirely by innate behavior patterns. These seem to be annually called into play when the seasonal flow of sex hormones stimulates special centers in the central nervous system.

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Big Bluff from Australia

By James A. Oliver

Chlamydosaurus kingi is the long and rather formidable scientific name of a rare, rather longish and sometimes formidable-looking lizard from northern Australia. The common name of Frilled Lizard is an easier one for most of us to use. Actually both names mean virtually the same thing since *Chlamydosaurus* is derived from two Greek words meaning mantled or cloaked lizard. The *kingi* is the scientific designation for the particular species and is based on the name of its discoverer, Captain King. On January 25 of this year the Frilled Lizard, *Chlamydosaurus kingi,* became a reality for us when two healthy specimens arrived safely to represent their species in our collections for the first time.

The Frilled Lizard is one of the most remarkable lizards in the world, primarily because of its unique frill or mantle but also because of its interesting habits. The frill is a large, umbrella-like structure surrounding the neck. When not in use it lies neatly folded alongside of the neck, and from a distance the creature looks ordinary and unspectacular. But as soon as the frill rises, it becomes awesome, certainly looking considerably larger in size. Adult males attain a larger size than females, sometimes reaching a length of three feet, and in them the raised frill may be as great as nine inches in diameter. The accompanying excellent pictures by Staff Photographer Dunton show clearly how much the frill increases the apparent size of the lizard beyond the diameter of the head.

The supports for raising the frill are elongated processes of the hyoid bones of the throat. The basal bones of the series articulate with the lower jaw in such a way that the frill can be raised only when the mouth is opened, and it must be fully opened to raise the frill to full size. However, the mouth can be opened, as when eating, without the frill being raised.

This frill is a truly spectacular example of a threat or "scare" structure. It is raised in an instant and the resulting transformation in the

lizard is amazing. Much of our knowledge of the natural history of this interesting reptile was obtained in the late 19th Century by W. Saville Kent in northwestern Australia. He found considerable differences in temperament between individual lizards. Some could not be induced to raise the frill under any circumstances while others, usually large males, were easily excited to the point of putting on a complete display of their defensive behavior. He commented on "the general habit they manifested, if much excited, of standing at bay with open mouths and erected frills, uttering a hoarse, hissing noise, and lashing whip-wise at the intruder with their long, rough tails. The blows thus delivered were dealt with such vigor as to smartly sting the hand if exposed to the impact."

LEFT—The Frilled Lizard in unalarmed pose with frill folded back. BELOW—The frill is up and the mouth open when an enemy, in this instance an Australian snake, comes close.

Our two lizards are docile to the point of being phlegmatic. We tried to excite them with quick motions on our part, with a cat approaching in a threatening manner and with an Australian Sulphur-crested Cockatoo nodding quickly toward them, but all without success. Finally we took an Australian Tree Snake and allowed it to crawl toward the lizard. When the snake got within about a foot of the lizard's head the effect was startling, the lizard flashed its frill to full capacity and the snake departed in the opposite direction. This is the only way that we can induce either of our lizards to perform this feat for us – by letting a snake crawl toward it.

The effectiveness of the frill is enhanced by the fact that the brightest and lightest colors of this otherwise drably colored lizard are on the front of the frill. Males are more brightly colored than females. Kent says that the colors form a mosaic pattern of orange, vermilion, steel-blue and varying shades of brown. One of our specimens is a male and the other a female. The frill

The frill at rest behind the lizard's head is always folded in the same creases. Both males and females have frills, and the male's is the brighter of the two. This is the male lizard.

of our male is somewhat more colorful than that of the female, but the brightest color is a reddish-brown. The brighter pigments recorded by Kent may indicate considerable individual variation in this respect or may suggest a seasonal change. The Frilled Lizard is a member of the Family Agamidae, a group of lizards found only in the Old World. Males of several species in this family are noted for their marked change in color during the breeding season, when they become much brighter than females. Possibly a similar change takes place in the Frilled Lizard.

These lizards are partly arboreal and are found in the wooded scrub-lands, frequently on the trunks or lower limbs of large trees. The fingers and toes have long, sharp, recurved claws that enable the creatures to climb with agility. Frilled lizards are among a small number of species in both the Old and New World that can run on the hind legs alone. This unusual method of locomotion is employed when great speed is needed. The Frilled Lizard, with its frill flapping loosely at the side of its neck, looks especially odd when proceeding in this manner. Kent says that it will run for 30 or 40 feet in this fashion, rest momentarily on all fours and then be off again. When he first reported his observations in 1895, no other lizards were known to have such an unusual type of locomotion. This amazing feat and the unique frill evoked a comparison of the lizard with mythical dragons and fossil dinosaurs. In fact, the name "Frilled Dragon" is sometimes used for it. Of course, it has no affinity with such imaginary animals as dragons and is no more closely related to the reptilian dinosaurs than other living lizards. Kent managed to bring one live specimen to London where it performed its bipedal locomotion before a group of eminent scientists. So strange were its ways that one zoologist followed it excitedly on hands and knees. While we have learned much about the ways of lizards in the intervening years, there is still a great deal to be learned and *Chlamydosaurus kingi* is still a species to evoke interest and enthusiastic study.

Spring Comes Along—Eventually

By DONALD T. CARLISLE

MANY of our members would like to know just when and where we greet spring at the Zoo. Why we keep the following information to ourselves year after year we frankly do not know, for it seems quite certain that many a member would have a fine day of it taking a small child to the Children's Zoo on opening day.

The folk who decide these matters have to say "1st good weather weekend" as they plan the spring openings of our Souvenir and Service Stands, and the outdoor refreshment opportunities at Lake Terrace. All sorts of quick bites at the latter but no hot coffee nor tobacco at the Service Stands. The Big Wheels assign definite dates for all the other openings.

Flamingo Terrace resumed operations for 1955 on March 19. That's the restaurant in Bird Valley between the Eagles and the Aquatic Bird House. Here you can get cafeteria service in hot meals. Candy, publications and camera films on sale too.

Boaters ahoy since March 26! You rent rowboats at the Boathouse east of the Boston Road Gate. The charge is 75¢ an hour, 15¢ extra for each fifteen minutes of overtime use, and $1.25 deposit on the craft. No discount to professionals from the U.S.N. No rentals after 5:30 p.m. and a curfew at 7:00.

Young Mothers and others harrassed by the smaller small fry can rent *strollers* from April 2 through the season — at all gates except big bronze Rainey Gate. The charge is 60¢ for three hours' use (no rebate if you use it for only two) and 15¢ per hour for overtime. There's a $3.00 deposit necessary — and this stroller service is one of our more humane gestures.

The same day, April 2, service will be resumed at *African Terrace* restaurant — down near the Boston Road Gate, across the way from the entrance to the African Plains. Sandwiches and other light refreshments. Candy, films and publications too.

On April 9 the *Zoobar* opens — one of the most attractive outdoor luncheon spots on the Eastern Seaboard. Here you may sit under the plane trees, sip your beer, listen to music and watch the elephants play leap frog — all this at mild expense.

Right over the fence on April 9 the *Children's Zoo* will begin its 1955 season. This is something not to be missed — the little fellers mixing it with the critters for the first time this year. Admission for adults involves juvenile accompaniment: Big folks 16¢; little ones 21¢. The fun will start at 10:30 a.m. and the animals will all yell "Uncle" at ½ hour before Zoo closing time.

On April 16 the *Farm-in-the-Zoo* will be opened again with horses, cattle, hogs, sheep, goats and all forms of domestic poultry except maybe guinea hens. But there will be baby chicks hatching sous cloches, and cows will be milked at intervals. A great place for youngsters to meet their more important animal friends. Everybody over 4-years old pays 16¢ to get in, except that school or other organized groups with leaders come in free. Hours: 10 a.m. to ½ hour before closing.

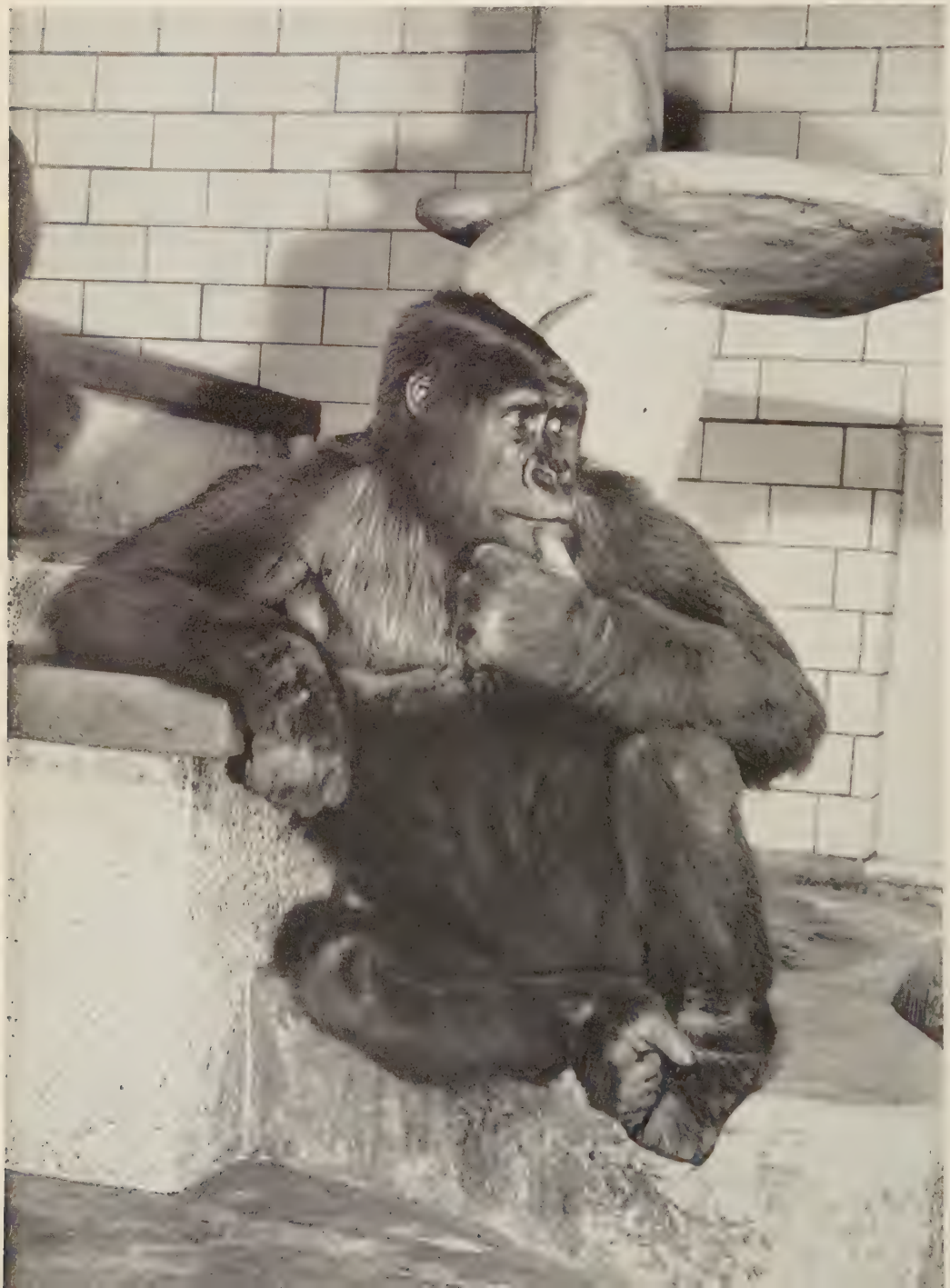
On April 16 the Farm Service Stand also opens with our regular line of service-stand merchandise *except* that we add "rube" souvenirs and rural straw hats.

You must save your questions until *April 24* when the *Question House* leads with its chin and dares any and all to come up with some stumpers. Besides *free* information about animals and where the subway is, we *sell* publications and film including motion picture film there.

Later on we will let you know about the Annual Garden Party for Members at the Zoo. But please don't wait 'til then. Come up for some of these other events. They're *all* fun.

ZOO NEWS IN PICTURES

BY SAM DUNTON



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A young Giant Otter from Brazil, the first in our collection. It is about 40 inches long, but old males may reach seven feet.

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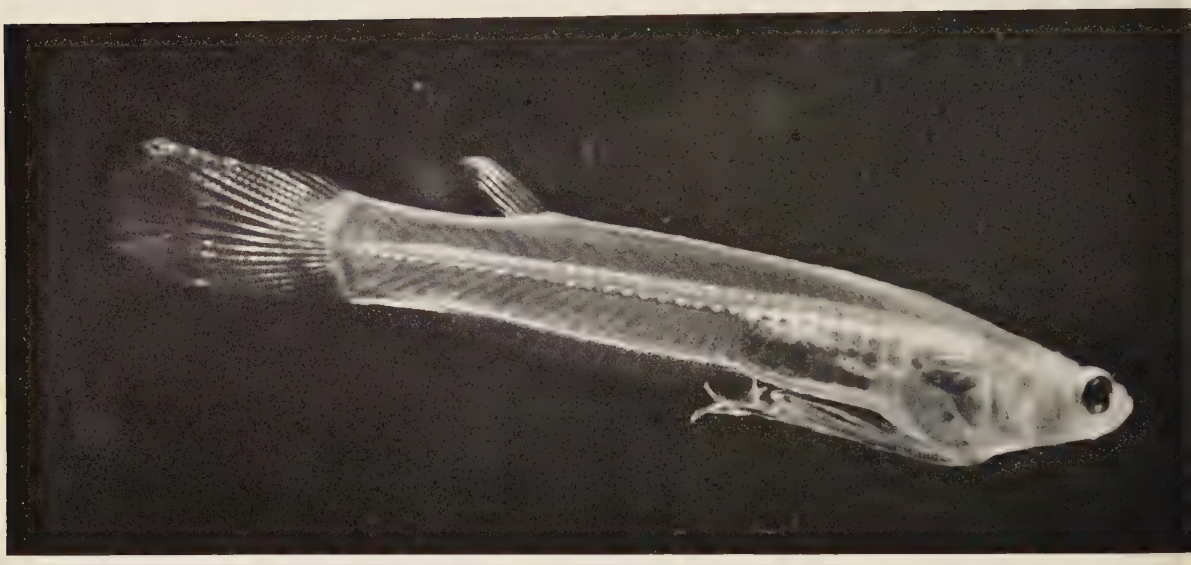
The larger of the two seals below is the Gray Seal, recently received. It shares a pool with a much smaller Harbor Seal.

Bright-eyed and healthy, this baby Congo Potto is being reared by hand in the Animal Hospital, and is gaining weight.

THOSE PUZZLING

"LITTLE TOMS"

By MYRON GORDON



On a day early in June of 1954 I received a telephone call from Herbert R. Axelrod, at that time an official of the World-Wide Aquarium Supply Company of New York, who requested aid in identifying some curious, inch-long, semi-transparent fish that had been shipped up from South America.

"We aren't interested in them," he said. "They aren't colorful and they have no commercial value. They're very delicate; I've just a single live pair left out of a hundred or more. You can have them all, dead and alive. I'm just curious to know what they are."

The Genetics Laboratory of the Aquarium gets many inquiries like that and I took the call as routine and agreed to accept the fish.

That afternoon Mr. Axelrod came in with two pint cardboard coffee containers. One was marked "Live," the other "Frozen." I poured the live fish into a small, oblong glass observation jar and looked closely at the tiny, translucent slivers that swam in a peculiar way. Although they were only an inch long, they were adults and a pair. The thinner one resembled the males of such live-bearing fishes as guppies and platyfishes in one trait — the peculiar makeup of the anal fin. It originated just behind the head and continued close to and parallel to the body to about a third of the fish's entire length, and extending from the end of the fin was a pair of antler-like processes. To an ichthyologist, such a fin is unusual — to say the least — and my mind flashed back to a picture of such an organ I had seen not long before. Donn Rosen, an associate in the Genetics Laboratory, had made drawings of the variously-constructed anal fins of live-bearing fishes for our study of the functions of these organs. The males do not use their anal fins for

swimming but rather for transferring sperm to the females during mating. Because of this specialized function the anal fins of males are called gonopodia, sexual appendages.

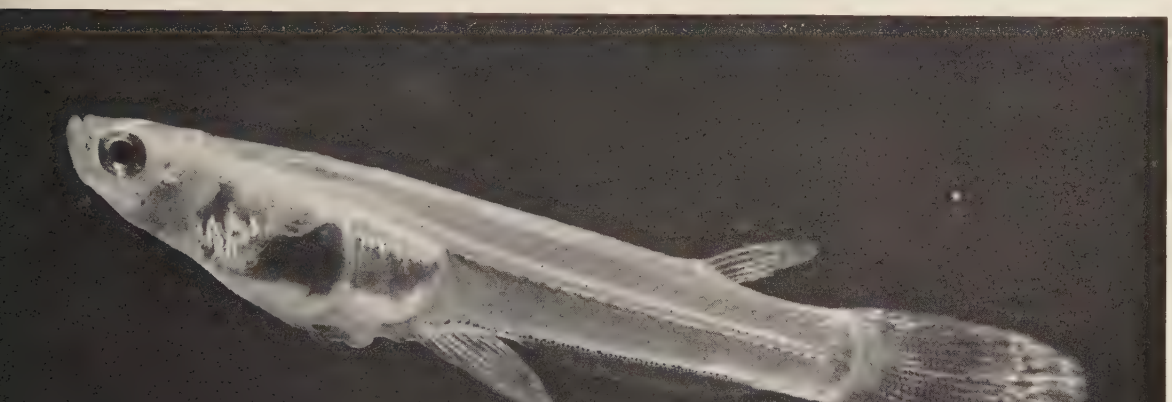
I took down the Zoological Society's scientific journal *Zoologica* for 1953 and found what I was looking for in our Text-figure 41. The legend said in part: "Distal tip of the gonopodium of *Tomeurus gracilis* Eigenmann."

"That's it," I said to the fish importer. "Your fish is a *Tomeurus;* there isn't another in the world with an anal fin like that. Our drawing was made from a pickled specimen in the Museum of Zoology of the University of Michigan. Hardly anything is known about its manner of life, but it's reported that the female *Tomeurus* doesn't give birth to living young, as you might expect. It's supposed to lay one egg at a time. As far as I know these are the only living *Tomeurus* in the United States."

"That's right," the importer said. "I gave a pair each to two aquarist friends of mine, but they couldn't keep them alive. This is the last pair. But how are you going to keep them?"

I glanced at the tiny fish again. They kept near the surface, swimming in a way that was peculiar for fish so small — in a sinuous fashion like eels or aquatic snakes. I got the impression that this surface swimming might be associated with a pelagic existence in large bodies of water; they might frequent the broad estuaries of South American rivers, like those of Venezuela and British Guiana. Certainly they were known from those parts of the world.

On a hunch I decided to do two things. I lowered the level of the water of an aquarium to about four inches. This would give them a large surface area in relation to the volume of water. Then I dissolved two heaping teaspoons of coarse, pure table salt in a small quantity of water and poured it into the aquarium. If they were inhabitants of the waters where sea and river meet, a bit of salt would make them feel at home.



The male Tomeurus at the left has its anal fin folded against the body; the female is at the right. These tiny fish are only about an inch long, and their slender bodies are transparent.

Once the pair was settled in the shallow waters of an aquarium I gave them a thimbleful of live daphnia. They quickly went after these tiny aquatic crustaceans, lifting their heads in a peculiar way and revealing surprisingly large mouths. The important thing was that they were eating. I sprinkled a pinch of pulverized fish food on the water, and they picked it from the surface film and swallowed it. For the time being I felt that I had done everything I could; the rest was up to the fish. In the meantime I ordered some dried brine shrimp eggs. The newly hatched nauplii might be one of their natural live foods.

Although I had no doubt that the fish was *Tomeurus,* it is always well to check these things. Technically, many of the live-bearing poeciliid fishes can be positively identified by examination of the males' gonopodia under the microscope, and fortunately there was plenty of material for examination in the coffee container of frozen specimens.

The fish were stuck together like anchovies in a can. As they thawed out I found to my delight that there were many males among them. Their antler-like anal fins protruded at grotesque angles and it took some delicate manipulating to detach them. The first glance under the binocular microscope revealed an amazing mechanism of prongs, spines, hooks, pads, and other special structures for which no names have yet been coined, and confirmed my original surmise that the fish was *Tomeurus.* Its anal fin was as unique and diagnostic as a fingerprint. When the frozen mass was fully sorted, I had more than a hundred specimens, including fully developed males and females and a goodly number of immature fishes. Surprisingly there were seven embryos not yet hatched from the egg. Their eyes were well formed but hidden beneath the wisps of transparent tails coiled around their bodies.

Finding seven dead embryos well along in their development was puzzling. I could not remember another instance of embryos being collected with their parents. Furthermore, the embryos, still within their eggs, were attached by filamentous tissues to the gonopodia of the males.

I let my imagination take over. Was it possible that the complex anal fin of the male was used as a sort of grappling organ, to seize the egg by the mass of sticky attached threads just as it was expelled from the female? Such behavior would presuppose some sort of preliminary courtship and coordinated mating performance. Of the mating habits of the adults nothing was known. The idea that the gonopodium was a sort of a basket to catch, to hold and carry the developing egg until the embryo was ready to hatch was, I admitted, fantastic. But it had one virtue: it would explain why the fertilized eggs and embryos were found attached to large males.

On the third day after their arrival in my laboratory, the "Little Toms" looked better than on the second day. On the seventh I was surprised to find a single embryo in its egg, floating on the surface. The embryo was dead. That was unfortunate, but the pair apparently had bred, and might breed again. Every day I inspected the aquarium carefully, but found no more eggs.

During July and August I had to be away. I left the Little Toms in the care of an assistant with instructions to observe them carefully and feed them on their special diet of daphnia, dried food and brine shrimp. At the end of the summer the two little fish were fatter, but no one had seen another egg or embryo.

Then one day I noticed that the female's belly bulged lop-sidedly. Since she was as pert as ever I suspected her of carrying an unreleased egg. Next day she was her trim self again, so I searched for the egg she might have shed. Nothing. Maddeningly, during the days that followed, she would be alternately bulging and trim, yet we found no results of her activities. I am sure now that the pair actually bred many times during that period; we simply were not aware of what was going on and consequently never searched diligently enough for the eggs that must have been there.

At the end of November Donn Rosen returned from the army to his post as assistant in the Genetics Laboratory. One of his first questions was about our success with *Tomeurus.* Since he was interested and competent, I suggested that he take the pair of Little Toms to his section of the laboratory and watch them.

A week later he called me over to the *Tomeurus* tank and indicated a mass of aquatic plant filaments and gravel particles.

"Take the hand lens and look at that *Nitella* filament," he said, pointing to a particular strand of algae. I did so, and there it was — an egg! It was in an early stage of development, beautifully camouflaged in the slightly brown-tinted water, about an eighth of an inch in diameter and semi-transparent and amber colored. It could easily have been mistaken for a small snail.

That discovery — and the revelation that two more eggs had been deposited, one stuck to the glass of the aquarium and another among the gravel particles — confirmed our belief that this member of a live-bearing group of fishes was ac-

tually an egg-layer. All of the eggs looked clean, free of fungus and definitely alive. In one the black eyes of the developing embryo were bright, a good sign that it was healthy.

In the next few days the changes within the eggs were imperceptible. More days and then weeks went by and we became concerned because none of the eggs had hatched. They seemed as viable as the day they were found, but – they just didn't hatch. The eggs of other tropical fishes, the Medaka and Paradise Fish for example, hatched within a week; some took only two or three days. Could it be that the eggs of the Little Toms required a special environment?

Before making radical changes, we resolved to make a thorough inspection of one of the more advanced embryos. Under the microscope its eyes could be seen to be still covered by the tail within its cellophane-like enveloping membrane. But things were advancing; circulation of the blood had started. We decided that all the eggs needed was more time.

Finding another egg each day became routine. Mr. Rosen's curiousity was thoroughly aroused. "I'm finding eggs on plant filaments and on the glass walls and in the gravel on the floor," he said. "How does she do it? I wonder whether the male helps out?"

"You may have to get up very early in the morning to find out," I replied. "Some fish, like the Japanese Medakas, spawn just at daybreak. Maybe we can trick these Tommies into thinking it's dawn. Try covering their aquarium and then taking the cover off at your convenience. That's the way Dr. Robertson and Dr. Rugh induced Medakas to spawn on command."

Mr. Rosen went immediately to place cardboard around the *Tomeurus* aquarium, leaving only the front glass open and darkening the tank considerably. In a few hours, I supposed, he would create an artificial dawn by lifting the covers off. But it was only a matter of minutes until he was back in my office.

"Well, I just saw the female lay an egg."

"But you covered them only five minutes ago."

"I did – that's when it happened."

He went on to say that just as he finished covering the aquarium he saw the female separate herself from the male, getting as far away from him as she could. In a far corner she seemed to be looking about, testing spots here and there by mouthing the plants, the gravel and the glass of the aquarium. Then she went into a sort of vibratory dance, twisting her body into an S-curve. She then tilted her body as if she were going to lie down on her side. Still vibrating she drifted within a quarter of an inch of her chosen spot and released her egg with some force. It struck a jagged part of the glass in the corner of the aquarium and stuck to its point of contact by many adhesive threads. The egg could be lifted out by passing a needle among those sticky threads.

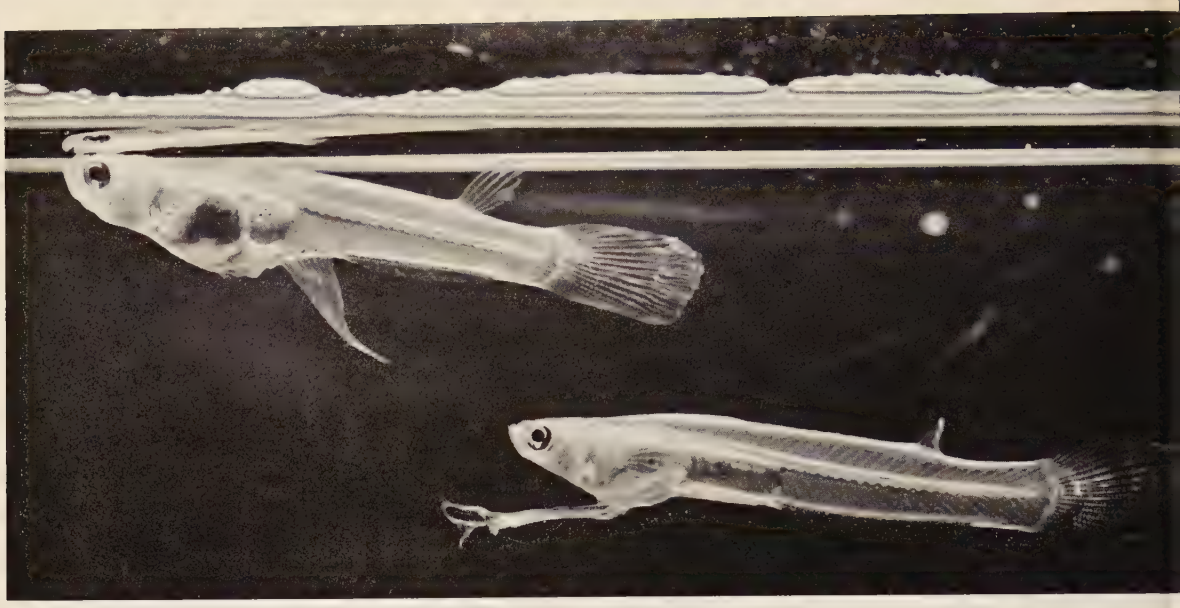
Obviously, our ideas were reversed; the Little Toms spawn at dusk rather than at dawn. And, as Mr. Rosen pointed out, their egg laying was not technically *spawning*, because the male had nothing to do with it. It was a solo performance, more like a female insect ovopositing an egg.

The next stage in discovery of the mating behavior of the fishes involved the male's use of the gonopodium – the antler-tipped anal fin. In bright light the female usually avoided her mate, but on occasions when the light was reduced by covering all but the front glass her guard was down. He lunged at her with his gonopodium thrust forward and struck her from behind and below. Instantly the water was agitated violently as the male almost leaped out of the water. If this was the consummate act in their mating performance, it was far different from that of viviparous fishes such as the platy or guppy.

Immediately following this curious behavior Mr. Rosen inspected the female. Six tiny, white, cyst-like objects were attached to her large, keel-like anal fin. He had previously noticed similar specks on that fin but assumed that they were the cysts of the protozoan *Ichthyophthyrius*, a dread disease organism known as "ich" to every keeper of tropical fish. The specks on the female *Tomeurus* always disappeared in a short time, so he gave the Little Tom no special treatment.

One of the six white spots was picked off and slipped under a microscope. Careful pressure crushed the cyst and from it flowed a stream of transparent, flagella-propelled oval objects. They were spermatozoans! The cyst was a spermatophore.

What appears to have happened is that, when the light was dim, the male attempted to make



The male Tomeurus, below, has its anal fin extended, and this photograph gives some indication of the complex appendages at the tip which are used for transferring sperm.

gonopodial contact, directing the point of the anal fin so as to transfer its spermatophores to the genitalium of the female. In this instance his timing and direction were off, so that the self-sticking spermatophores were ineffectually planted on his mate's anal fin.

From December 8, 1954, to February 1, 1955, no fewer than 42 eggs were found in the aquarium. The first one hatched on January 3, having required 30 days at a water temperature of 76° F. It survived only four days. The second hatched on January 10 and lived twenty-five days. The third, fourth and fifth babies disappeared within a day.

We are a long way from knowing all the requirements of the hatchlings. Mr. Rosen thinks that they do better at 80° F. than at a lower temperature. We don't know how much salt they need in their water. We *have* learned that hatching is no guarantee of survival.

News that the Zoological Society's Genetics Laboratory was harboring living *Tomeurus* spread across the country. In September I received an inquiry about them from Dr. George S. Myers, Curator of the Natural History Museum at Stanford University in California. He said he had been trying for years to get live *Tomeurus* to complete his study of them in cooperation with Carl L. Hubbs of the University of California.

I replied that since I had only a single living pair, I did not dare risk shipping to the West Coast, but I offered six pairs from our preserved collection, and these he accepted.

When, last December, I reported to the staff of the Zoological Park that I had enough information to consider an article in *Animal Kingdom,* the announcement aroused James W. Atz, Assistant Curator of Fishes and the Society's bibliophile, to start searching the literature for information about *Tomeurus,* particularly its habitat and life under natural conditions. We soon discovered that very little had been published, but Mr. Atz's ingenuity suggested other sources. *Tomeurus* is found in British Guiana, and thirty-five years ago Dr. William Beebe and the staff of our Department of Tropical Research were working at Kartabo, up the Mazaruni River. Might there be references to *Tomeurus* in the unpublished field notes of Dr. Beebe, John Tee-Van and Clifford Pope, who had done much of the work on fishes? He searched the fading pages of Tee-Van's notebooks and came upon a bonanza. Apparently the field station had been much interested in *Tomeurus* and there were many references to its natural history.

To the Creole peoples of Kartabo, these little fish are known as "Lowa-lowa lice." The white

people of the region call them Sword-finned Minnows because of their conspicuous lance-like gonopodium. The local Indians have no name for them, possibly because they are of no importance as food.

Tomeurus lives in the mouth of the Essequibo River and thus is under the influence of oceanic tides. On this point, my lucky guess that the Little Toms required some salt in their water environment was correct. They swim, sometimes scores of individuals together, close to the surface. When surprised near the banks of the river or its tributaries they scoot out into open water, seeking shelter under masses of river froth, floating leaves and sticks. They feed on small winged insects and on spiders that fall and are held in the surface film. Beneath the surface they catch smaller crustaceans, such as shrimp, copepods and daphnids. Often they are trapped in backwater pools which are exposed to the tropic sun, yet the "Lowa-lowa lice" tolerate the heat. On this point Mr. Rosen was correct in his feeling that they require somewhat warmer water than we generally maintain in our tanks.

The most dramatic notes contributed by Clifford Pope were those concerning the day-by-day history of six live embryos that he obtained by squeezing them out of a gravid but dying female *Tomeurus*. They began on July 22, 1920.

23/VII/20. The female spoken of just above died yesterday, late. This morning I took her out and *easily* pressed out six eggs – all with embryos. It would appear as if they had been carried there as they were only joined to her by loose threads. Circulation in 4 is very plain; also jerking movements of the embryos.

24/VII/20. The five eggs doing well. Each is 1¾ mm. in diameter. *Tomeurus* is easily approached and the only fish of Kartabo beach that can be readily caught with a short handled net. When once in the net they spring around like little jumping jacks.

25/VII/20. Embryos developing; all five eggs alive. Examined another female *Tomeurus*. Found 3 "eggs," two clear – one a small embryo.

28/VII/20. The five eggs of *Tomeurus* (first batch) doing well. The dark blotches still growing larger and running together as are the red ones. The eggs show tendency to become translucent. The eyes (? dark bodies one on either side at one end of embryo) are very dark for first time.

30/VII/20. *T. gracilis* eggs alive.

2/VIII/20. The black of the 5 *T. gracilis* eggs is losing its intensity, continuing to become more and more like the branched red spots. The body of embryo is beginning to be differentiated. Pulsations still originate just anterior to head of embryo.

6/VIII/20. Yesterday the two eggs of *T. gracilis* in a separate dish were dry – the whole dish was dry – as I was sick and did not attend to it. One egg was alive and is still so today, the other I threw out today. Two of the five also were not good this morning and I threw them out.

7/VIII/20. Last one of the two *T. gracilis* eggs doing well.

21/VIII/20. Getting ready to leave. The last of the 6 *T. gracilis* eggs is apparently about to hatch.

Pope's observations throw a revealing light on *Tomeurus'* close affinity to viviparous poeciliid fishes. Simply stated, the Little Tom female is capable of retaining within her body not only fertilized ova but well-developed embryos as well. This explains why we had found embryos among adult Little Toms in the frozen mass preserved by the fish importers. While enroute to the United States some females had apparently released their embryos and the filamentous threads attached to the eggs had become entwined about the gonopodia of the dead males. Pope's discoveries also explained why I had found a single, not-long-dead embryo in our laboratory aquarium after our pair of *Tomeurus* had been with us for only six days.

Why are the ichthyologists around the world concerned about this tiny, diaphanous fish? It is because *Tomeurus* is a biological paradox. The male has a complex anal fin elaborately designed for the transfer of sperms to insure internal fertilization – yet the female lays eggs. If the Little Toms were like all other live-bearing fishes to which they are definitely allied by many anatomical traits, the females should give birth to already-hatched living young. She doesn't, and therein lies the paradox.

The paradox will be resolved only when we learn more about the rarer live-bearing fishes and their egg-laying relatives. We are already aware that one egg-laying species, *Fundulus*, the killifish of our Atlantic coast, occasionally retains embryos within its body in the manner of live-bearers. On the opposite end of the range of variability, the live-bearing mosquito fish, *Gambusia*, of our southern states, may be made to release her embryos prematurely, and they hatch and survive. The more we consider the live-bearing and egg-laying fishes, the more we are drawn to the conclusion that viviparity and oviparity are relative terms and not necessarily mutually exclusive. *Tomeurus*, so casually presented to us, has certainly opened up interesting avenues of study.

Creatures of Sea Ice and Tundra Barrens

By KATHARINE SCHERMAN, New York
&
RICHARD S. MILLER
Biology Department, Harvard University

ON AN EXPEDITION to Bylot Island in the Canadian Eastern Arctic last summer, we became unexpectedly interested in the little ringed seal, *Phoca hispida*, of the far northern coastal waters, bays and inlets.

The study of sea mammals was not our primary aim. We had been sent by the New York Zoological Society and the Arctic Institute of North America to study the ecology of a small area of tundra barrens. We wanted to work out as far as possible the relation of plants, birds, mammals and insects to one another; their adaptation to the short, explosive Arctic spring, with its perpetual sunlight; their even more surprising adaptation to Ice Age conditions – permanently frozen ground and frequent below-freezing temperatures.

Bylot Island is about the size of Connecticut. It lies on the 73rd parallel, 450 miles north of the Arctic Circle, and it is a place of tundra, glaciers and forbidding, tall, jagged mountains. In the summer it is beset by wild storms; in the winter it is closed, silent, deeply frozen. It is uninhabited by man. The farthest northern limit of Eskimo civilization in that region is north Baffin Island, twenty miles to the south across Eclipse Sound.

LEFT—The expedition rounding Button Point on t way to Akta cliff, the haunt of Murres and Kit wakes. RIGHT—Part of the enormous nesting co onies at Akta, a spot seldom disturbed by visito

Photographs by Axel Rosin & Katharine Scherman

In June and July of 1954 we eight city-bred Americans made our invasion of this unfriendly land. We intended to make ourselves at home in a small village of tents on its cold, windy southern shore, to explore the treeless tundra that rose in gentle terraces away from the sea and to learn the ways of the dangerous, rotting sea ice, and of the creatures that lived under it.

In early June we landed by plane on the sea ice – still, happily, frozen solid – near a small settlement, Pond Inlet, on north Baffin Island. Eskimos and the seven white men (police, traders, missionaries) of this far-northern Canadian town piled us and our mountainous baggage on dog sleds and took us across the twenty miles of sea to our lonely island.

The dog sleds whispered and swayed like little

boats on a white desert on which nothing moved. Snow fell lightly, and the dark mountains of Bylot Island were shadows in the fog. But as the caravan reached its destination, the Aktineq River, on the southern shore of the island, the sun came out, low and golden, across the mountains. It was late at night, but at that latitude

the sun does not set at all from May until August. At about six in the evening it sinks to the level of the mountains and circles slowly from northwest to northeast for about eight hours. Then the ragged peaks send long shadows far out over the tundra and the sea ice, and the whole world turns pale gold. There is a chill, thin purity to the air, extraordinarily exhilarating.

Our expedition had arrived at almost the first moment of the Arctic spring. When we got there the tundra was still thinly covered with snow and it seemed a place of silence and desolation. But within a few days the snow started melting rapidly and soon the sound of rushing water was everywhere as the little rivulets opened and the big Aktineq River broke its ice barrier. The tundra quickly came alive before our eyes. And more slowly the frozen sea, cracking and rotting from the soft spring fogs and the blazing sunshine and the surging tides of the open ocean, exhibited to us its myriad life.

The first birds were just arriving. The Greater Snow Goose, which does not breed any farther south, came in great flocks to court and feed on the edges of the melting inland ponds. Shore birds — Baird's and White-rumped Sandpipers, Red Phalaropes, Ruddy Turnstones, Golden and Black-bellied Plovers — came and almost immediately set up housekeeping. Far back on the tundra we found the Rock Ptarmigan that changes its feathers, almost one by one, to accord with the changing of the tundra from snow-white to summer brown. A host of little songbirds, Snow Buntings, Northern Horned Larks, American Pipits, Lapland Longspurs, fluttered into the air as we walked, and floated gently to earth, warbling enchantingly as they warned us off their land. Old Squaw Ducks squawked in the beach lagoons continuously, night and day, like an amateur chorus — badly out of tune and never together. Huge, pale gray Glaucous Gulls circled our camp, looking for garbage. One shadowy, foggy day Arctic Terns appeared, looking like ghost-birds. This far wanderer flies an estimated 25,000 miles a year, wintering in the Antarctic and summering in the Arctic, and sees more daylight than any other living creature. An occasional Snowy Owl drifted over the tundra like a piece of fog, and Long-tailed Jaegers, beautiful, slim predators, made miserable the lives of smaller birds. On the cliffs on the ocean side of the island were thousands of nesting Kittiwakes and Murres and a sprinkling of King Eiders, Dovekies and Guillemots.

The first spring flowers were blooming in places where only a few hours earlier there had been snow. Brilliant cerise saxifrage was the earliest. As the sun warmed and thawed the top few inches of the earth, multitudes of small plants came to flower: dryas, white and wide-eyed; heavy carpets of white-flowered, red-leaved Arctic heather (*Cassiope tetragone*); Arctic poppy, yellow, long-stemmed and frail-looking, which grew where nothing else would grow and withstood wind and sleet and below-freezing temperatures; violet-blue *Erysimum pallasii* in tight, perfectly round clusters; moss pink, buttercups, lousewort, daisy fleabane. The tundra was covered with mosses and lichens in intricate patterns and subtle colors. (Some of the young birds had exact replicas of these patterns and colors in their

ABOVE—The Ringed Seal is so named because the soft pattern of dark rings on the silvery hid
RIGHT—Pups are born usually in March or Apr and in the first weeks their fur is a creamy-whit

infant plumage). There was even a tree. It was called Arctic willow, and it generally grew about four inches high, though it can live to the age of eighty years.

Solitary bees worked busily among the blossoms. They did not swarm nor build hives; they lived in empty Lemming holes or old birds' nests, and they preserved themselves in winter by a kind of deep-freeze. Small butterflies hovered over the flowers and large, clumsy mosquitoes hatched and danced their slow circles above the warm mud of inland pools. Spiders and beetles stalked through the tiny jungles of Arctic heather and willow.

The tundra was honeycombed with the holes and passages of the multitudinous Lemming, but we saw few of them. Foxes and weasels, though we never saw them, were active in destroying birds' nests, and white Arctic Hares hopped nimbly over the melting snow.

The sea was full of life too. The gray and white Arctic Terns swooped over black open-water leads, searching for young Tom-cod. Ducks and geese fed on algae, baby shrimps and seaweed in the shallow beach lagoons. Long-tusked Narwhals paraded ponderously down the leads, and Arctic Char, a small Salmon, leaped at the river mouths.

* * *

So much for the background — the "habitat," as it were — of our expedition. The scientific results of our six-weeks' stay on Bylot will be presented in technical papers by other members of the party. There is room here only for an account of *Phoca hispida,* the small seal which enlivened all our trips over the sea ice.

On our first trip across Eclipse Sound, when we set up our base camp on Bylot Island, our eyes had strained through the dead whiteness, looking for anything that moved, anything alive. At that time of year, before the birds have come and the snow has melted, there is nothing to be seen in the northern wilderness — except seals. In the beginning we could not see them at all; it takes the eyes a little while to become accustomed to seeing small motion at a great distance. But in an hour or so we began to notice black specks through the fog, and soon we could distinguish form and movement. An infinitesimal head moved up and down at regular intervals; a tiny, dark, distant form was suddenly no longer there. Eclipse Sound, it appeared, was full of seals. We passed their agloos (breathing holes), slow brown whirlpools in the white ice. Occasionally we found evidences of a recent meal — a dead shrimp, left behind in a hasty departure. Once, beside a rough heap of snow, the "igloo" of a

mother seal, an Eskimo picked up a hunk of soft, yellowish fur – hair of a baby seal.

Much of what is known of the Ringed Seal comes from Eskimo observations. Since the animal is the center of their economy, these alert, wise and observant hunters have made themselves thoroughly acquainted with its life and habits. White men, neither prizing its skin nor liking the taste of its meat nor having much opportunity to study the habits of this almost inaccessible seal, have learned little of its peculiarities. We learned about *Phoca hispida* from our Eskimo friends, as had interested observers before us.

The Eskimos have an extraordinary sympathy for the little seals which are their main source of livelihood. The Ringed Seal figures importantly

graph by Ian McLaren, Fisheries Research Board of Canada

in their folklore, and the Eskimos believe that a man can become a seal (and be quite happy in that state). They believe, also, that the seal likes being killed. Death is like a little drop of cool water falling on its head. On the other hand, if the seal escapes, the Eskimo hunter murmurs a blessing over its agloo.

But with all their mystic rationalization, these hunters are remarkably keen observers. Living in a land where man is merely one amid several large predators, the Eskimo himself is part of the balance of nature, and he is as quick as an animal to sense and understand the movements of other animals.

The Ringed Seal is found all around the North Pole, and as far south as Labrador and the Bering Sea. Apparently it has no urge either to congregate or to migrate. It seldom ventures into the open ocean but lives out its quiet, mostly solitary life in bays, fjords and inlets. In Russia and Finland there are Ringed Seals in freshwater lakes; they also occur in Hudson Bay.

Early whalers looked curiously, but not covetously, at the little creatures dotted over the ice of straits and sounds, far from the storms and predators of the open ocean. They called them "ice rats" because of their small size (adult males do not exceed six feet). And they noted that the Eskimos of Greenland and the Canadian Eastern Arctic used them for nearly every household purpose. The "ice rats," difficult to catch and lacking the soft inner fur of the Alaskan Fur Seal, never excited commercial greed. Consequently their population has remained fairly stable throughout their range.

They were classified in the family Phocidae, which includes the Harbor Seal, Alaskan Ribbon Seal and Greenland Harp Seal. This particular *Phoca* was at one time dubbed *Phoca foetida,* because of the peculiarly unpleasant odor of the old males. The Eskimos call these old males "tiggak" – stinker.

"When brought into a hut, and cut up on its floor," wrote one 19th century observer, "such a seal emits a smell resembling something between that of asafoetida and onions, almost insupportable to strangers." Eskimos, however, eat them without a grimace.

Today they are known scientifically by a more respectable name, *Phoca hispida* (rough-haired). The common name, Ringed Seal, refers to the soft pattern of dark rings on the silvery hide.

The seal mother commonly has one pup a year, born in March or April. To prepare for its coming she digs a hollow between the sea ice and the snow which lies on it. This has no entrance from above, but a passageway under the snow leads to her breathing hole, so that the mother seal can come and go in the water without disclosing her nest.

At birth the pup weighs four to six pounds. For the first weeks of its life it lives entirely on extremely rich milk – the fat content of the related Gray Seal is reported to be greater than that of elephant milk, previously thought to be the

richest. The pup gains weight and size rapidly, and by the time it is ready to feed itself, at about four weeks, it is nearly three feet long and owns a heavy layer of fat. Actually, when it becomes adult, fat and hide will make up about two-fifths of its weight. At about four weeks the baby fur begins to give way to the adolescent hide known commercially as "silverjar," coarse-textured and subtly shaded, pale silver and darker silver, with the rings a shadowy pattern on the back, fading out entirely on the belly.

At this stage the mother takes her baby into the water, teaching it to swim and by example showing it the food that seals eat. Soon after that she leaves her pup. Ringed Seals do not gather in colonies. But the young, frightened at being left alone, sometimes draw together in small groups for a little while, living off their own fat, and complaining. Soon, however, they discover that shrimps are easy to catch, and later they realize that Tom-cod and Sculpin taste quite as good as milk, and that the sharp cusps on their tricuspid molars are useful for holding fish. Then they no longer need one another's company.

Phoca hispida, in common with other true seals, is remarkably well adapted to life which is carried on almost entirely under water. When the seal goes below the surface it *exhales* before diving (a human being *inhales* before diving). As it sinks the seal's normal surface heart-beat of about 150 a minute drops to ten. The oxygen content of the body decreases from 20% to 2% in the course of the dive, a condition that prevents the "bends." In this (to human beings) extremely low physical condition, it functions perfectly, swims fast, hunts its food, escapes its enemies. Under water its ears and nostrils are closed. It uses its eyes to some extent – they are adapted both to underwater and surface vision – but its whiskers are probably of great importance at this time, too. Large, sensitive nerves attached to the whiskers probably enable the seal to feel vibration. As tactile organs they may show it where its food lies, giving warning when enemies approach, even tell it when it has reached the surface. There is on record an old, totally blind Gray Seal that when captured was healthy and had a full stomach, indicating that some sense other than sight is operative.

After fifteen minutes the seal must come up for air. As soon as its nose is in the air it takes deep breaths. The carbon dioxide is exhaled and normal metabolism is restored within a few seconds.

During winter and spring, when the bays and inlets are frozen, the seal uses breathing holes, about three feet in diameter. Eskimos say seals can cut these holes with the sharp claws on their flippers through six feet of solid ice. It is also probable that they begin making breathing holes when the first thin film of ice forms, and keep them open simply by using them.

If the seal feels sleepy and replete it reclines on the ice beside its agloo. Its heavy layer of fat allows it to lie for hours on the ice without any loss of body heat. But even while apparently asleep it is alert. About every thirty seconds its head goes up, seemingly unconsciously, and it searches the sea ice for danger, using both nose and eyes. Although its eyes are said not to be very efficient, it is apparently extremely alert to motion. A wary seal will sometimes dive when a hunter is still a quarter of a mile away.

Phoca hispida has few enemies. The Polar Bear stalks it silently on the winter ice (in the summer the bear follows the pack ice on the open ocean, far away from the haunts of the coast-loving Ringed Seal. The Arctic Fox occasionally takes a pup in the early spring. In late July tribes of Killer Whales enter the straits and inlets, wantonly killing everything in sight. These creatures eat voraciously. The stomach of one Killer Whale was found to contain thirteen porpoises and fourteen seals – though the animal was less than twenty feet long! Another had twenty-four seals inside it, and had choked while trying to eat the twenty-fifth.

The little seals scatter before these killers, often clambering up on shore, even into an Eskimo village, to escape the dreaded enemy. A seal has been known to dive between a man's legs and stay there, trembling with fear, while the Killer Whales caroused in the water. But Killer Whales do not often come into inland waters. And even when they do, the Ringed Seals are not murdered *en masse,* since they do not colonize.

The chief enemy of the little seal is man. Since the virtual extermination of the immense Caribou herds of the Canadian Eastern Arctic the Eskimos there have centered their economy on

Phoca hispida. The pretty and abundant little creatures provide food for people and dogs, skins for clothing, leather for boots and dog traces, fuel for the huge soapstone cooking lamps and the smaller lighting lamps. An Eskimo hunter has estimated that he must take two hundred seals a year to feed and equip his family and animals. In the summer he can take a few Narwhals and an occasional Walrus or Bearded Seal. In the winter and early spring he sometimes gets a Polar Bear. But his main source of livelihood is the Ringed Seal. It also has a small commercial value in Canada. A sealskin brings from fifty cents to three dollars at the Hudson's Bay Company trading posts, depending on the age and condition of the skin.

There is, at the moment, no danger of extermination of the Ringed Seal. There are not many Eskimos in the far northern, inhospitable places where *Phoca hispida* thrives. And even if the hunters wanted to, they could not go on orgies of killing. The seal leads a solitary life and is extremely wary and difficult to hunt. In the dark, bitter winter the hunter must stand for many hours over a seal agloo. His family, even the littlest children, guard other breathing holes on the ice. If the seal shows its nose they drive it down, until it must finally, sometimes after a whole day, come up where the hunter's harpoon is poised. In the spring the Eskimo stalks the seal over the ice, creeping behind his white seal shield. Often the cautious and sensitive animal notices even the slow motion of the shield. Then the hunter must lie on the ice and clap his feet together, raising his head up and down as if he were just another seal, to soothe the nervous animal. If he can get close enough to shoot his aim must be perfect. For if the seal is only wounded, even mortally, it will exhale, dive into its agloo and sink instantly. Later in the spring the Eskimo hunts along open-water leads – and here again his aim must be perfect. After he has shot the seal in open water he must harpoon it immediately to pull it up on the ice, because even a dead seal sinks within a few minutes. Needless to say the Eskimo hunter does not waste expensive amunition on random shots, so few seals are lost through careless wounding.

Though man is its chief enemy, men in the far north are both too few and too wise to be a serious threat to the Ringed Seal. The gentle and wary mammal, scattered and solitary, hunted by few, consequently leads a remarkably calm life. Nature has equipped it to have but one pup a year, so the population stays at a level in keeping with the slim food supply of these frigid waters. In the frugal world of the north, which abounds neither in predators nor victims, *Phoca hispida* exists in perfect harmony with its surroundings, absolutely adapted to its icy world.

News from the Conservation Foundation

Job Possibility Survey

During the last few years the Conservation Foundation has been directly responsible for the establishment of one graduate training program in conservation and has been closely associated with the development of several others. During this same period we have received innumerable requests for guidance in conservation training and employment from individuals interested in the field. A systematic study of the sorts of positions which are now available and which might be developed has just been initiated under the direction of Mr. Roger Hale. Mr. Hale's many years of business experience, with his specialized training in the Yale Conservation Program, give him an unusually satisfactory background for such a study. He will analyze the product of the various institutions now giving graduate training in conservation and in addition will study the market for such individuals in business, industry and government. A report on the findings of this study will be completed by the end of the year.

Eastern Water Law

An analysis of the water problem in the eastern part of the United States has just been begun by the research division. This study will examine the various factors involved in the legal control of water by various states. Over the last few years there has been considerable agitation for changes in water law. The emphasis of this study will be on legal analysis and the bearing of laws on economic development. Since the solutions may be achieved through administrative change, through engineering development, or simply through better use of water as well as through legal change, all of the facets of the problem will be examined.

The entire project is under the direction of Mr. Stephen Bergen, a member of the Research Department staff. The legal analysis is being conducted by Professor David Haber of Yale Law School. The ultimate scope of the study and its form of publication will be reported later.

Bighorn Sheep Project

Excellent progress reports are coming in from Dr. Helmut K. Buechner, who is in charge of the current study of the splendid animals often spoken of as "Rocky Mountain" Sheep. A recent letter speaks of an aerial census he made of Bighorns in the Yellowstone region on Thursday, February 10, at a temperature of 19° below zero. He counted 189 animals from the air and added three more seen on the ground the following day. His letter ends with the statement, "I am repeatedly thrilled with the fine project I have before me." Our great hope is that this study of all Bighorns from the Canadian to the Mexican Border will contribute to a clearer understanding of ways to ensure their long-term protection.

Conservation Achievement by Industry

The Audio-Visual Department is collecting examples of industrial achievement in the field of conservation for potential film, book and other educational purposes.

Some sixty stories have already been received from eleven leading industries and the Manufacturing Chemists' Association, and more are expected to be made available for review and evaluation.

Fifty Years of Forestry

The Conservation Foundation was fortunate in being one of ten institutional sponsors of the Fiftieth Anniversary Dinner of the U. S. Forest Service held in Washington on February 4. President Osborn represented the Foundation at the meeting. The program, in which most conservation leaders participated, emphasized the high professional standards of the Forest Service and noted the progress which this important conservation agency has made.

BEHIND THE SCENES

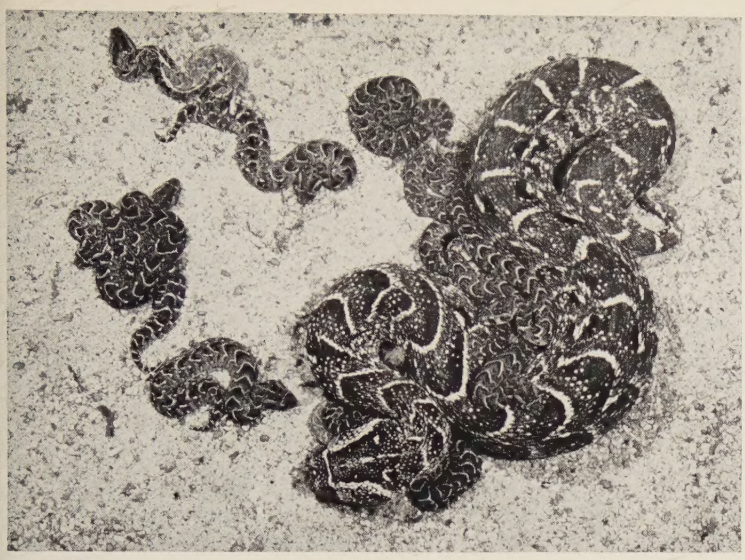
NEWS AND NOTES OF THE ZOOLOGICAL PARK, THE AQUARIUM AND THE DEPARTMENT OF TROPICAL RESEARCH

How Many Bear Cubs?

Any time in the next week or two we expect to see the first excursions of our Black Bear cubs — and to learn definitely how many we have. Keeper Joe Ruff heard infant squalls in the mother's rocky den on the morning of January 31, and a few days later the mother emerged with one cub in her mouth. She drank at the pool and carried the cub back to the den. The following day she came out with two cubs and the keeper believes he could distinguish the sound of one cub inside while the two were with their mother. We will know whether we have two, or three, only when they are large enough to come out under their own power. — W. Br.

President Osborn Honored

President Fairfield Osborn has been informed that by action of the King of the Belgians he has been made a member of the Institut des Parcs Nationaux du Congo Belge.



A litter of African Puff Adders born in the Reptile House collection on Feb. 28. There were 28 alive and 2 dead, and the youngsters (6 or 7 inches long) are thriving. Several of them will be presented to other zoos.

It's Baby Time, All Right

In one 10-days' period in mid-March we acquired eleven animals by birth – not a record for a comparable period, but not bad for a preview of the spring season in the Zoo. The newcomers included seven Mouflon and one each of Aoudad, Blue Duiker, Blackbuck and Llama. The latter, born on St. Patrick's Day and inevitably named Patricia, is probably going to be one of the stars of the Children's Zoo.

We Have Another Callimico

Last December we received what appears to be the first Callimico or Goeldi's "Marmoset" ever exhibited outside its native South America. Being so rare in zoological collections, it could hardly be expected to turn up again in a few months – but it has.

Our first specimen was not in very good condition when it arrived, and it died on January 21. It was of such considerable interest that it was sent to Dr. G. E. Erikson of the Harvard Medical School for external examination and was subsequently sent by air to Dr. W. C. Osman Hill, Prosector of the Zoological Society of London, for still more detailed anatomical studies and reporting in a later volume of his work on the Primates.

Unexpectedly, on March 1, we were able to acquire a second specimen of this rare primate. It is lively and vigorous and is currently being cared for in the Animal Nursery. – W. Br.

Special Train to the Zoo

The New Haven Railroad will run a special "Zoo Train" to the Zoological Park on April 16 from Springfield, New Haven and Bridgeport. If the experiment is successful, similar special trains will be run during the summer.

"Let's Litter Less"

The anti-litter posters, "Let's Litter Less," designed by the Zoological Park and put up for the first time last fall, have attracted national attention. The "Keep America Beautiful" Association has reproduced one poster which is being widely distributed by the Garden Club of America and there have been many requests for samples and sets of the nine posters.

PUBLICATIONS OF INTEREST

AMPHIBIANS AND REPTILES OF WESTERN NORTH AMERICA. By Robert C. Stebbins. Pp. xxii + 529, 104 pls. and 52 figs. McGraw-Hill Book Company, Inc., New York, 1954. $8.50.

All students of North American herpetology, but especially those residing in the western part of the country, will welcome this excellent book by Professor Stebbins of the University of California. Here is a comprehensive book covering all species of amphibians and reptiles found in western North America – the area west of the eastern boundaries of Mackenzie, Saskatchewan, Montana, Wyoming, Colorado and New Mexico. The book is illustrated thoroughly by the skilled sketches of the author and includes at least one illustration of every form and a complete distribution map for

each species. The treatment is by species with subspecies being considered under the section on distribution at the end of each major group. The emphasis is on identification but Stebbins is an able field naturalist and includes a summary of the known habits for each species, including many of his personal field observations. This is a grand reference for amateur and professional alike. – J.A.O.

THE WATERFOWL OF THE WORLD. By Jean Delacour. Sixteen plates in color by Peter Scott and thirty-three maps. Vol. I. Country Life Ltd., London, 1954. £5.5s (app. $15.00).

While there have been many publications covering the swans, geese and ducks in part, it seems rather curious that up to this time no complete coverage of the group, of the magnitude of the present work, has been attempted. This, perhaps, may be as well, for the combined experience of author and artist with waterfowl in nature, in the museum specimen case and in captivity, could hardly be matched. Following the reorganization of waterfowl systematics advanced by himself and Dr. Ernst Mayr in the Wilson Bulletin, 1945, the author has covered, in this first volume of a projected set of three, the Magpie Goose, the Whistling or Tree Ducks, the Swans, the true Geese and some others, including the Sheldgeese or Upland Geese, the Shelducks and the Steamer Ducks. Under each group, species and race will be found description, distribution and an account of habits in the wild and in captivity. Peter Scott's illustrations are so superbly done and perfectly reproduced that the smallest racial differences are readily discernable. The two volumes to come will be eagerly awaited. – L.S.C.

MARLIN PERKINS' ZOOPARADE. By Marlin Perkins. Endpapers and sixteen full-page plates in color by Paul Bransom and numerous black and white drawings by Seymour Tleishman. Pp 96. Rand McNally & Co., Chicago, New York and San Francisco. $2.95.

In this attractive volume the author uses the technique so successful in his popular television program of the same title. A living animal or a pleasing drawing catches the eye of viewer or reader, an anecdote or two holds his attention and before he can drift away, he has been exposed to more natural history information than might otherwise have reached him. In twenty-two short chapters, Mr. Perkins introduces as many kinds of mammals, most of them well known to television watchers or zoo visitors. Paul Bransom's lovely paintings add much of interest and Mr. Tleishman's drawing are adequate. – L.S.C.

New Members of the New York Zoological Society

(Between January 1 and February 28, 1955)

Benefactor

John H. Phipps
David Rockefeller

Founder

Dr. Henry Clay Frick
Gilbert W. Kahn

Patron

Miss Anne Phipps

Life

Robert E. Blum
Mrs. Ebben Schramm Llewellyn
Mrs. Bernard Peyton, Jr.
DeWitt Wallace
Mrs. DeWitt Wallace

Contributing

George Payne Bent, II
Mrs. D. Fairfax Bush
George A. Chamberlain
Mrs. William L. Chenery
Miss Ruth Auchincloss Child
George Clausen
Mrs. W. Murray Crane
Mrs. Livingston Cromwell
Miss Linda Darnell
Coleman duPont Donaldson
Duncan S. Ellsworth
Mrs. F. Sheffield Faulkner
Dr. F. Gudernatsch
Dr. Robert H. Halsey
O'Donnell Iselin
Frederick W. Jackson
Frederick P. King
Mrs. George W. Kosmak
Mrs. Clifford D. Mallory
William H. Mathers
Walter Mendelsohn
William Miloscia
Mrs. Louis deB. Moore
John M. Morehead
Gustaf A. Nyden
George W. Perkins
Warwick Potter
Auguste G. Pratt
Otto H. Reisser
Mrs. M. Roessel
Mrs. E. Schelling
Thomas L. Smith
Mrs. Andrew V. Stout
Harvey M. Thomas
Mrs. Jeannette Watson
Mrs. John J. Weber
Samuel A. Welldon
Mrs. William P. Willetts
Morrie R. Yohai

Annual

Alfred Reginald Allen
Mrs. Reginald Barclay
Miss Ellen E. Black
Mrs. Adolphe Boissevain
Dr. George Brown
Mrs. Francis H. Cabot, Jr.
Mrs. Hawley T. Chester
Dr. L. R. Christensen
Morris Cohen
Mrs. Dorothy E. Connell
Mrs. Edgar M. Cullman
Mrs. William R. Deering
Charles Marden Fitch
Miss Gladys M. Freeman
John Galm
Carroll Gilleran
E. Godfrey
Mervin J. Goldin
Simon Gross
Mrs. Helen W. Hansen
Mrs. Cora A. Hull
Miss Ruth W. Jones
Robert M. Kelly
Mrs. Henry G. Laykind
Philip K. Levy
Mrs. Walter S. Mack
Mrs. William C. Mayer
Master Daniel Metraux
Henry W. Metzler
Gerard L. Moench
Frank J. Muhlfeld, Jr.
Ector O. Munn
Mrs. Stone Philipp
Miss Adelaide I. Richter
Rocco Rosato
Mrs. Arthur Rous
Mario A. Ruffolo
Charles B. Sackett
William R. Saner
Mrs. Philip S. Sears
Ellison Ward Smith
Mrs. DeWitt Stetten
David B. Stone
John D. Warren
George J. Wilder
Stanley Wolf